

A new genus and species of terrestrial flatworm from the central highlands of New Caledonia (Tricladida Terricola)

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ABSTRACT

A new endemic genus and species of terrestrial flatworm, *Pimea monticola* is erected and described from New Caledonia. It is characterized by an antero-ventral adhesive organ, specialised insunk ventral cutaneous musculature, and a

copulatory bursa associated with the male copulatory organs. *Pimea* probably differentiated from geoplanid stock with ventral testes, strong cutaneous longitudinal muscles and absent parenchymal longitudinal muscles.

RÉSUMÉ

Description d'un genre et d'une espèce nouveaux. *Pimea monticola*, endémique de Nouvelle-Calédonie. Le genre est caractérisé principalement par la présence d'un organe adhésif musculo-glandulaire en position antéro-ventrale, pourvu d'un muscle rétracteur constitué par les fibres musculaires longitudinales sous-épidermiques immergées. Les testicules et les canaux déférents sont ventraux. Les organes

copulateurs sont dépourvus d'adénodactyle. Les ovaires sont pourvus de réceptacles séminaux et la bourse copulatrice s'ouvre dans l'atrium mâle. Le pénis possède une papille intra-péniale. *Pimea* s'est probablement différencié à partir de Geoplanidae à testicules ventraux, à muscles cutanés longitudinaux forts et dépourvus de muscles parenchymateux longitudinaux.

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The terrestrial flatworms of New Caledonia and the Loyalty Islands were described by GRAFF (1899), BUSSON (1903) and SCHRÖDER (1923). Of the 21 species described, 13 are endemic to New Caledonia, and comprise 10 species of *Geoplana* (Geoplanidae) and three species of *Rhynchodemus* (Rhynchodemidae). The original descriptions included full anatomical accounts for only two species, *Pelmatoplana willeyi* Busson, 1903 and *Geoplana forsterorum* Schröder, 1923. More recently KAWAKATSU (1969) reported on the copulatory organs of *Geoplana cookiana* Schröder, 1923, a previously described species.

In the course of two research projects of the ORSTOM (Institut Français de Recherche Scientifique pour le Développement en Coopération) (ecology) and Muséum national d'Histoire naturelle (MNHN) (systematics, phylogeny and biogeography), 107 specimens of terrestrial flat-

worms were collected from 46 stations in various regions of New Caledonia. Ten previously identified species have now been tentatively identified, but in addition there are a number of undescribed species. This paper describes a new endemic genus and species from the central highlands of New Caledonia.

Materials and methods: collections were made monthly from 25 square metre quadrats in the leaf litter at stations in which all the flora had been inventoried (ORSTOM), and from leaf litter at numerous stations in various regions of New Caledonia (MNHN).

The holotype was fixed in the field in 4% formaldehyde solution, and subsequently processed to paraffin wax, sectioned at 7 µm, and stained by the MALLORY-HEIDENHAIN and other histochemical methods (WINSOR, 1983).

Family GEOPLANIDAE Stimpson, 1857

Genus *PIMEA* n. g.

Type species: *Pimea monticola* n. sp.

Etymology: the generic name comes from a pre-colonial Melanesian clan, the Pime, one of many clans in the region south-east of the type locality. The specific epithet is derived from the Latin *mons* a mountain and *colo* to inhabit, and alludes to the locality in which the species was first recorded.

Diagnosis: Geoplanidae with elongate body; creeping sole almost one third of the body width; anterior end expanded; single glandulo-muscular organ (adhesive pad) located antero-ventrally; longitudinal cutaneous musculature well developed; muscle bundles smaller dorsally than ventrally; ventral cutaneous longitudinal musculature partially insunk into the parenchyma internally to the cutaneous nerve net to form the retractor muscle for the glandulo-muscular organ; dorsal cutaneous muscles integrated with parenchymal transverse muscles form glandulo-muscular organ extensor muscle; ventro-lateral sensory zone restricted to neck, with few small sensory pits; testes ventral, uniserial; vasa deferentia

situated on the lateral aspect of the ventral nerve cords; copulatory organs without adenodactyls.

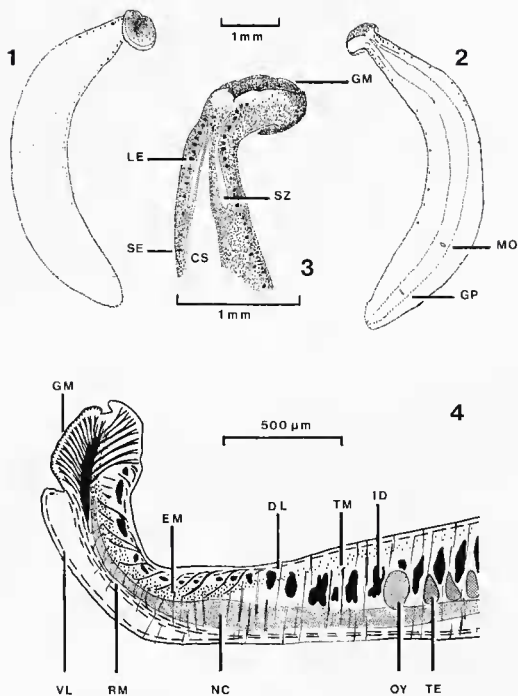
Pimea monticola n. sp.

Holotype: serial sagittal and transverse sections of the anterior, pre-pharyngeal and posterior regions on a series of 21 microslides. The type, register number UC 95, is lodged in MNHN.

Type locality: a single specimen was collected at Station 92a in wet forest, 1 000 metres altitude on the summit of Mt Aoupinié, 165°15'52" E, 21°10'46" S, by P. B. MORDAN, A. and S. THILIER, 5th May, 1987.

External features: the preserved specimen (figs 1-2) is very small and elongate, measuring 11 mm by 1.7 mm maximum width (length-width ratio 1 : 6.5). The ventral mouth is situated 7.2 mm behind the anterior tip and the gonopore 1.8 mm behind the mouth. In cross section the body is convex dorsally, near-flat ventrally.

The expanded anterior end (head), 1.2 mm wide and 1.5 mm long, is rounded anterolaterally. The ventral surface consists of a single



FIGS 1-4. *Pimeu monticola* n. g. n. sp. 1 : dorsal view of holotype ; 2 : ventral aspect of holotype ; 3 : ventral aspect of the anterior end ; 4 : a diagrammatic representation of the principal internal structures of the anterior end.

CS, creeping sole ; DL, dorsal cutaneous longitudinal muscles ; EM, extensor muscles ; GM, glandulo-muscular organ ; GP, gonopore ; ID, intestinal diverticulum ; LE, large eyes ; MO, mouth ; NC, nerve cord ; OY, ovary ; RM, retractor muscles ; SE, small eye ; SZ, sensory zone ; TE, testis ; TM, transverse muscles ; VL, ventral cutaneous longitudinal muscle.

glandulo-muscular organ, the protuberant pad of which exhibits a slight median indentation near the creeping sole. The periphery of this organ is slightly crenulate.

Behind the anterior end, the body gradually broadens to maximum width over the pharynx, then evenly tapers to a rounded end. The creeping sole is almost a third of the body width and extends from the posterior tip to the narrowest part of the body immediately behind the expanded anterior end.

Unpigmented sensory zones lie ventro-laterally either side and slightly beyond the creeping sole anteriorly. A single row of ocelli are present either side of the base of the anterior end and extend posteriorly along the ventro-lateral margin of the body. The eyes are large anteriorly, decreasing in size posteriorly. Ocelli do not extend anteriorly beyond the proximal margin of the adhesive pad (fig. 3).

The dorsal ground colour is a uniform dark tan, paler sub-marginally and ventrally to the inner ventral zone (though the tan colour may be a fixation artifact (WINSOR, 1983)). The creeping sole is white.

Body wall and musculature : the epithelium is thicker dorsally ($20\ \mu\text{m}$) than ventrally ($12.5\ \mu\text{m}$), and is separated from the cutaneous musculature by a fine bi-fibrillar basement membrane, with no evidence of pigment granules. Only the creeping sole appears ciliated, with cilia $4.3\ \mu\text{m}$ long mid ventrally, and is 27% of the pre-pharyngeal body width.

Rhabdoids of the rhabdite type, obovate in shape, are secreted by mesenchymal rhabditogen cells. Rhabdites pack the dorso-lateral epithelium and extend ventrally to the edge of the creeping sole. Mid dorsal rhabdites measure approximately $14\ \mu\text{m}$ by $4.5\ \mu\text{m}$ in greatest width and are slightly larger than those most ventrad which are approximately $12.5\ \mu\text{m}$ by $2\ \mu\text{m}$ wide. Histochemically they are composed of basic protein. Dorsally and laterally in the anterior portion of the body, the rhabdites are present in the epithelium as clusters (fig. 5).

The dorsal epithelium of the head differs from that elsewhere. There are few rhabdites and micro-rhabdites. The epithelium is strongly acidophilic from the presence of fine grained secretions and larger spherical bodies derived from glands between the dorso-ventral muscle fibres.

There are at least two types of both acidophil and basiphil glands which are particularly numerous in the mesenchyme. Acidophil glands occur peri-intestinally and are concentrated infra-intestinally. In the anterior third of the body acidophil secretions pass to the anterior end to serve the glandulo-muscular organ and dorsal epithelium of the head. Strongly basiphil glands are located peri-intestinally ecally to acidophil glands, and glands situated infra-neurally service the creeping sole. Paler staining basiphil glands are prominent in the dorsal mesenchyme. Histochemically both types of basiphil glands contain secretions of neutral mucin or glycoprotein.

The cutaneous musculature is well developed and composed of the usual three sets of muscles : an outer layer of circular muscles, an inner sheath of bundles of longitudinal muscles, both sets separated from each other by a set of decussate helical muscles. The pre-pharyngeal region of the body is a maximum of $527\ \mu\text{m}$ dorso-ventrally, the dorsal cutaneous musculature $29\ \mu\text{m}$ thick and ventral musculature adjacent to the creeping sole $32\ \mu\text{m}$ thick. The cutaneous muscular index (CMI) (WINSOR, 1983) is 11.5%. Laterally the musculature is reduced as the bundles of longitudinal muscles are smaller than those of the dorsum and outer ventral zone.

Overall the cutaneous longitudinal musculature has smaller bundles dorsally than ventrally. Anteriorly the ventral cutaneous longitudinal muscles thicken and divide with the major portion insunk into the parenchyma ecally to the cutaneous nerve net. The muscle bundles deepen and form the ventral retractor muscle for the glandulo-muscular organ (fig. 4). Posterior to this division the ventral cutaneous longitudinal muscle bundles are small and poorly defined over the creeping sole. Individual fibres are scattered and insunk in the parenchyma (fig. 8).

Between the cutaneous musculature and the gut the compact mesenchyme contains numerous collagenous fibres, glands, protonephridia and weak parenchymal muscles, principally circulo-oblique fibres. These muscles are most numerous laterally in the regions where the cutaneous musculature is reduced. Strong dorso-ventral muscles lie between the intestinal diverticula.

Prominent transverse muscles underlie the cutaneous musculature dorsally, and anteriorly with dorso-ventral muscles and insunk elements

of the dorsal cutaneous longitudinal muscles, develop into a thick compact infra-intestinal plate, the extensor muscle of the glandulo-muscular organ.

In the mid-parenchyma of the head the ventral retractor muscle and the extensor muscle meet and interdigitate through interstices in the neural tissue to form a dense muscular cephalic plate (fig. 4). From the plate thick fibres pass dorsally to the head, and ventrally to serve the glandulo-muscular organ.

Glandulo-muscular organ and associated structures : the glandulo-muscular organ consists of a single ovate pad separated from the adjacent body by a narrow peripheral groove. There is no median sulcus, and the creeping sole terminates well before the pad.

Two types of closely associated mucus glands open from the ectal margin of the groove which separates the organ from the adjacent epithelium (fig. 5). They are conspicuous basiphilic gland with granules of neutral mucin-glycoprotein, and the weakly basiphilic acid mucopolysaccharide secreting glands.

The glandulo-muscular organ is composed of numerous micro-pads on muscular columns between which secretions pass to the surface. Large bundles of muscle fibres, principally derived from the ventral retractor, extend from the plate to the organ. Some 50-60 μm from the surface these muscles extensively ramify and in small bundles of two or three fibres develop a right-handed spiral, terminating at the micro-pads. These structures (fig. 6) are 20 μm long and are enlarged where the muscles attach to the basement membrane. They narrow to a nucleate acidophilic epithelium bearing what appears to be compact modified cilia 2.8-3.6 μm long.

Four types of secretions are associated with the glandulo-muscular organ. Copious coarse granules up to 8 μm of basic protein secretions, derived from mesenchymal glands deep within the parenchyma, pass to the surface between the columns of micro-pads and at the margins of the organ. At the surface they coalesce, presumably forming an adhesive. Very weakly basiphilic, almost chromophobic mucoid secretions from mesenchymal glands also pass to the surface between the basic protein granules and muscular stalks. Histochemically these secretions are acid mucopolysaccharides. Basiphilic and acidophilic glands

lie between the muscle fibres deep within the organ. Their fine granular secretions, histochemically neutral mucins or glycoprotein, pass to the surface via long ducts which spiral up the muscular columns to the micro-pads. These secretions may include a releasor substance.

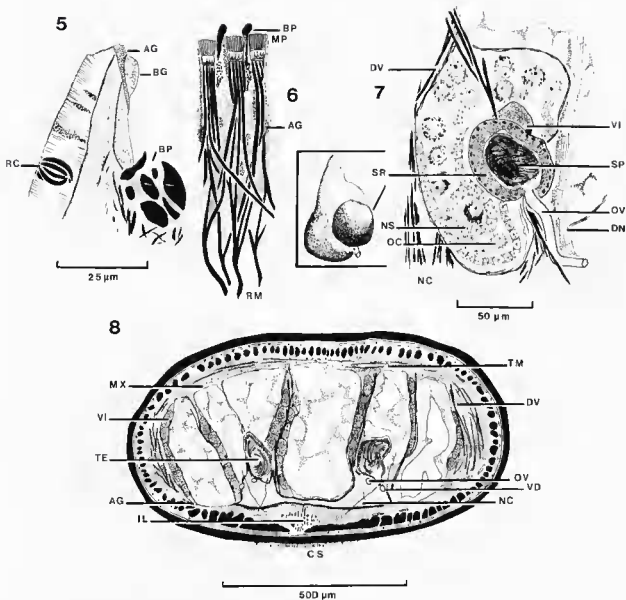
Alimentary system : the intestine is the usual triclad type with a single anterior ramus and two posterior rami diverging from the pharyngo-intestinal junction. There are approximately five intestinal branches per millimetre of body length. Each branch terminates in a not deeply divided lobulate diverticulum. Small diverticula terminate about 430 μm from the anterior tip of the head and overlie the extensor muscle. In this specimen the gut is empty and gastrodermis inactive.

The pharynx is cylindrical, 250 μm long, and almost horizontal in attitude. The dorsal insertion of the pharynx is posterior to the ventral insertion. The outer epithelium is ciliated and infra-nucleate, underlain by a layer of circular muscles and a layer of longitudinal muscles. The central portion of the pharyngeal wall contains ducts of basiphilic glands ectally, and those of acidophilic glands entally. The glandular areas are traversed by radial and circular muscle fibres. The lumen is lined by a ciliated infra-nucleate epithelium underlain by a layer of mixed circular and longitudinal muscles in basiphilic mesenchyme.

The pharyngeal pouch is 280 μm long (2.5 % of the body length), and is mostly lined by a flattened epithelium underlain by layers of circular then longitudinal muscles. A small diverticulum occurs in the mid posterior wall of the pouch.

Excretory system : protonephridia are present in the peri-intestinal mesenchyme, though they are not abundant and do not appear highly developed. End canals contain three or four flame cells, each 4-5 μm long and 1 μm diameter with a single flagellum and terminal nucleus. Ciliated convoluted tubules, final duct and exit canal are present, but could not be followed through the sections for any great distance.

Sensory organs : approximately 12-13 sensory pits spaced about 70 μm apart are situated in each of the unpigmented sensorial zones either side of the anterior creeping sole. The pits are



FIGS 5-8. *Pimea monticola* n. g. n. sp. 5: diagrammatic representation of the ectal margin of the groove surrounding the glandulo-muscular organ; 6: diagrammatic representation of the structure of the glandulo-muscular organ; 7: diagrammatic representation of the right ovary (inset: right ovary showing seminal receptacle, unscaled); 8: diagrammatic representation of the pre-pharyngeal (posteriad) transverse section.
 AG, acidiphil gland; BG, basiphil gland; BP, basic protein secretion; CS, creeping sole; DV, dorso-ventral muscles; IL, insunk cutaneous longitudinal muscles; MP, micro-pads of glandulo-muscular organ; MX, compact basiphilic mesenchyme; NC, nerve cord; NS, nurse cells; OC, oocyte; OV, ovovitelline duct; RC, rhabdite cluster; RM, retractor muscles; SR, seminal receptacle; TE, testis; TM, transverse muscles; VD, vas deferens; VI, vitellaria.

ciliated and shallow, measuring $14.2 \mu\text{m}$ long, $3.5 \mu\text{m}$ wide, with lumen $10.7 \mu\text{m}$ deep and $3.5 \mu\text{m}$ diameter.

Ocelli are of the pigment-cup type and $14\text{--}118 \mu\text{m}$ diameter. The largest eyes occur anteriorly, eye size diminishing as the ocelli pass caudally. Anteriorly the ocelli are about $80 \mu\text{m}$ apart with $18\text{--}30$ retinal rods each.

Nervous system : paired nerve cords $70 \mu\text{m}$ diameter pass anteriorly and thicken to $100 \mu\text{m}$ diameter at approximately the same point that the retractor and extensor muscles arise. Proximally to the cephalic muscular plate the cords thin, unite and expand laterally. The nerve tissue is perforated by dorso-ventral muscle and glands. Posteriorly, extensive transverse commissures link the nerve cords. The cutaneous nerve net is prominent dorsally.

Reproductive system : the two ovaries are situated 1.7 mm from the anterior tip, slightly embedded in the superior surface of the ventral nerve cords (fig. 4). Each ovary (fig. 7) measures $170 \mu\text{m}$ dorso-ventrally, $100 \mu\text{m}$ antero-posteriorly and $200 \mu\text{m}$ medio-laterally, with a prominent seminal receptacle, $50 \mu\text{m}$ in diameter, protruding from the mesiad side. The oovitelline duct emerges from the ventral aspect of the junction between the body of the ovary and the seminal receptacle, and passes posteriorly along the superior margin of the nerve cord.

Both ovaries contain maturing oocytes surrounded by nurse cells, and mature oocytes. The seminal receptacle is lined by a tall columnar epithelium with basal nuclei, and filled with tightly packed spermatozoa.

Vitellaria (fig. 8) lie in the parenchyma between the intestinal diverticula and pass their secretions via short vitelline funnels to the oovitelline duct.

Numerous mature testes ($18\text{--}20$ per mm body length) lie in uniseriably-staggered row between the intestinal diverticula, along the superior side of the ventral nerve cords (fig. 4). They extend from just behind the ovaries to immediately anterior to the pharynx. Each testis is roughly ellipsoidal, $180 \mu\text{m}$ dorso-ventrally and $50 \mu\text{m}$ diameter with a testicular funnel emerging laterally from the lower testicular pole to join the vas deferens passing along the lateral margin of the ventral nerve cord (fig. 8).

The copulatory organs (figs 9-11) lie immediately behind the pharyngeal pouch, surrounded by a thinly muscularized highly glandular stroma. The gonopore communicates with the atria via a $35 \mu\text{m}$ diameter foramen in the inter-atrial transverse septum. A copulatory bursa opens into the anterior upper quadrant of the male atrium just to the right of the midline. Ejaculate is contained within the bursa and male atrium. Atrial musculature comprises inner circular and outer longitudinal muscles with bundles of circular muscles present in the parenchyma below the atrial floor surrounding the ental opening of the gonopore.

Male organs. Throughout the penis, the course of the efferent duct is tortuous. The spermiducal vesicles, seminal vesicle, prostate, ejaculatory duct and penial duct are all individually circumscribed by a thin tunica, and clearly differentiated from each other by specific cell types and modes of glandular secretion.

The vasa deferentia curve mediad, distend, and unite in the mid body. Dorsal to this common sperm duct the vasa deferentia form large paired spermiducal vesicles. The common sperm duct proceeds to the seminal vesicle, lined by a tall, non-ciliated columnar epithelium packed with coarse secretory granules. Most of the secretions are acidophilic, some basiphilic, all secreted in a holocrine manner. Sperm are present in the lumen.

The seminal vesicle leads to the prostate which surrounds the duct lined by tall ciliated columnar cells through which fine acidophilic and basiphilic granules are secreted directly into the lumen. The prostatic tissue is composed of mostly strongly basiphilic intra-mural glands between which pass secretions of extra-mural acidophil glands.

Continuous with the prostate is the ejaculatory duct, lined by a non-ciliated, infra-nucleate columnar epithelium. Through the epithelium intra-mural acidophil glands pass granules which are secreted into the lumen in an apocrine manner. The ejaculatory duct terminates in an intrapenial papilla protruding into the capacious proximal penial duct. This duct extends and expands laterally behind the bursa and is lined by a low columnar epithelium with a brush border, suggesting an absorptive function.

The penial duct communicates with the male atrium via the penial sheath, a weakly muscularized passage lined by a ciliated epithelium.

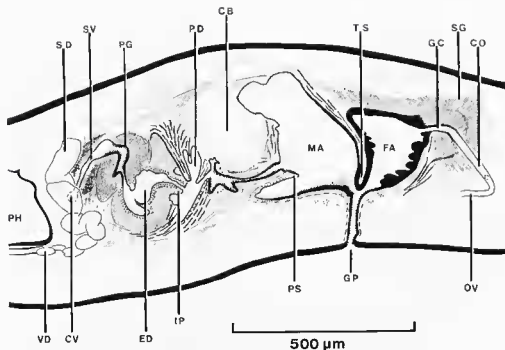


FIG. 9. — *Pimea monticola* n. g. n. sp. Diagrammatic mid-sagittal composite reconstruction through the copulatory organs. Note that the copulatory bursa (indicated by a broken line) is not a midline structure. For clarity, the ejaculate present in the bursa and male atrium has not been shown.

CB, copulatory bursa; CO, common oovitelline duct; CV, common sperm duct; ED, ejaculatory duct; GC, glandular canal; GP, gonopore; IP, intra-penial papilla; OV, ovovitelline duct; PD, penial duct; PG, prostate gland; PS, penial sheath; SD, spermiducal vesicle; SG, shell glands; SV, seminal vesicle; TS, transverse inter-atrial septum; VD, vas deferens.

The sheath terminates in a ventral tongue-like flap which protrudes into the atrium. The posterior third of the male atrium is ciliated, with a flattened nucleate epithelium lining the remainder.

Penial musculature comprises circular muscles surrounding the duct. In the seminal vesicle the circular muscles are widely spaced, in the prostate they are more tightly packed, and in the ejaculatory duct arranged in tightly packed bundles each of approximately three muscle fibres. Glandular areas are lightly muscularised by sparse longitudinal-oblique fibres. Strong retractor muscles surround the penial duct and are present within the inter-atrial septum.

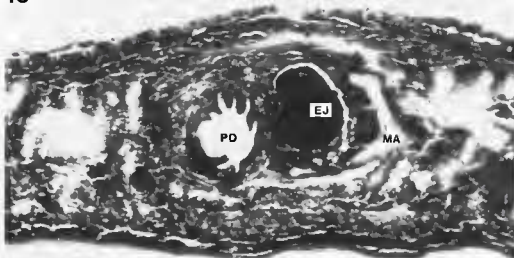
Female organs. The oovitelline ducts pass behind the copulatory organs before they incurve and unite to form the common oovitelline duct. The common duct ascends dorsad curving anteriorly to join the glandular canal which receives secretions from adjacent shell glands. The glandular duct opens into a small female atrium lined

by a rugose, basiphilic, tall columnar epithelium. Acidophilic granules pass through the epithelium to the lumen.

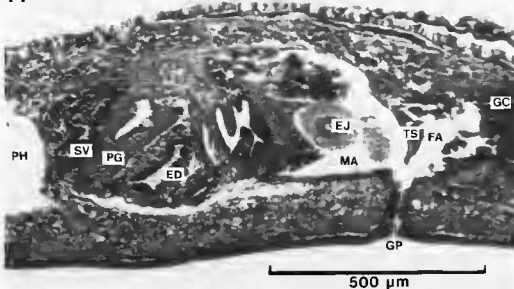
The copulatory bursa (fig. 10) is spheroidal, and approximately 200 μm diameter and is situated on the right of the body, admedially abutting the musculature of the penis sheath. A highly glandular stroma, weakly muscularised by interwoven longitudinal and oblique fibres, surrounds the bursa. Within the stroma are extensive sinuses containing amorphous basiphilic secretions of neutral mucin or glycoprotein. The hursal epithelium is difficult to discern because of abundant secretions surrounding the ejaculate present in the lumen.

The ejaculate is approximately 500 μm long and shaped like an elongate tear, with the broad end mostly within the bursa and narrow end occupying much of the male atrium. The ejaculate consists of an inner core of sperm mixed together with large acidophilic droplets similar to those of the seminal vesicle. Surrounding the

10



11



FIGS 10-11. — *Pinea monticola* n. g. n. sp., copulatory organs. 10. longitudinal lateral section illustrating the lateral aspect of the penial duct, the copulatory bursa and ejaculate; 11. medial longitudinal section.
ED, ejaculatory duct; EJ, ejaculate; FA, female atrium; GC, glandular canal; GP, gonopore; MA, male atrium; PD, penial duct; PG, prostate gland; PH, pharyngeal pouch; SV, seminal vesicle; TS, transverse inter-atrial septum.

core is an inner amorphous layer of strongly acidophilic secretion, a layer of basiphilic material, and an outer layer of a strongly basiphilic substance with attached acidophilic droplets. Layering within the ejaculate reflects the sequence of secretions within the penis, the outer secre-

tions appearing coagulated and totally enclosing the sperm mass.

Pathology : a small larval nematode is present in the infraneural parenchyma over the creeping sole. There is no evidence of tissue reaction.

DISCUSSION

Recent authorities, for example CANNON (1986), use the following characters to distinguish between families in the Terricola: number, size and distribution of eyes; shape of the anterior end; extent of the sensory groove; width and extent of the creeping sole; general body shape; elaborations of the head; and complexity of the copulatory organs particularly the presence or absence of a bursa and genito-intestinal canal.

Pimea monticola n. g. n. sp. has large multiple eyes laterally which extend only part way along the sides of the head; an expanded anterior end, not sharply defined at the neck, with an antero-ventral glandulo-muscular organ; few sensory pits in small sensory grooves parallel to the long straight-pointed beginning of the creeping sole; creeping sole flat and almost one third of body width; body robust with low length-width ratio; and complex copulatory organs with accessory glands and bursa. These characters largely accord with those of the family Geoplanidae to which the species is assigned.

Within the Geoplanidae the principal characters used to distinguish genera include: specialization of the anterior end; whether the testes are dorsally or ventrally situated; position of the male efferent system with respect to the ventral nerve plate; and musculature with particular emphasis upon the cutaneous and parenchymal longitudinal muscles. *Pimea monticola* has a single antero-ventral glandulo-muscular organ; ventral testes; male efferent system placed ventrolaterally on the nerve cords; and specialized longitudinal parenchymal musculature, derived from insunk cutaneous longitudinal muscles, serving the adhesive pad.

Three geoplanid genera have glandulo-muscular organs; two Neotropical genera, *Isoeca* Froehlich, 1955 and *Choeradoplana* Graff, 1890, and the Notogaenic *Coleocephalus* Fyfe, 1953. *Isoeca* has a single antero-ventral adhesive pad, dorsal testes, and retractor muscle formed by the cutaneous longitudinal musculature which is not insunk. The eyes and sensorial zone pass around the ventro-lateral margin of the anterior tip. Adenodactyls are absent from the copulatory organs.

Choeradoplana has paired antero-ventral adhe-

sive pads, dorsal testes, and retractor muscle formed from insunk elements of the cutaneous longitudinal musculature. The eyes in this genus do not pass around the anterior tip, but are restricted to the sides of the anterior end. The sensorial zones are present within the pad on either side of the anterior tip. Adenodactyls are absent from the copulatory organs.

Coleocephalus from Auckland Island, New Zealand, has a single hooded (cotyloplanid-type) adhesive pad, and dorsal testes. The eyes pass around the anterior tip. Adenodactyls are present in the copulatory organs. The musculature and sensorial zone of this genus have yet to be described (WINSOR, redescription in prep.).

It is concluded that the combination of characters exhibited in *Pimea monticola* from New Caledonia precludes it from being accommodated in existing geoplanid genera, and it is therefore placed in a new genus *Pimea*.

Longitudinal parenchymal musculature derived from cutaneous longitudinal muscles insunk internally to the cutaneous nerve net is found in *Choeradoplana*, *Pimea* and two Chilean genera of FROEHLICH (1978), *Gusana* and *Liana* without glandulomuscular organs.

The cutaneous and parenchymal longitudinal musculature, and the arrangement of the ocelli of *Pimea* is closest to that of *Choeradoplana*. The cutaneous musculature of *Pimea* is weaker than that of *Choeradoplana* and also lacks the strong transverse supra- and infra-intestinal parenchymal muscles present in some choeradoplans. In *Pimea*, ocelli do not pass around the anterior tip but terminate part way along the head as in *Choeradoplana*.

Distinctive features of *Pimea monticola* are the presence of seminal receptacles in the ovaries, and a copulatory bursa. The copulatory bursa is particularly unusual as it opens anteriorly from the male atrium and is closely associated with the penis. Within the Geoplanidae bursae are usually associated with the female atrium and copulatory organs. The composition and structure of the ejaculate in *P. monticola* is more complex and multilayered than normally observed in terricolan ejaculates, and may be more appropriately termed a spermatophore.

The structure and probable mode of action of the glandulo-muscular organ are complex. The adhesive pad is controlled by ventral retractor and dorsal extensor (protractor) muscles, the speed and displacement of which are probably amplified by the particularly strong dorso-ventral muscles of *Pimea*. The helical arrangement of fine muscles supporting the micro-pads suggest that the muscular columns can contract rapidly and strongly over a short distance. Secretory elements, particularly the predominant basic protein (assumed to be an adhesive) formed by secretory granules coalescing, appear to be similar to those observed by WILLIAMS (1980) in *Tennocephala novaezealandiae*.

Pimea is the first endemic terrestrial flatworm genus to be described from New Caledonia and thus of taxonomic and zoogeographic interest. With respect to the anterior glandulo-muscular organ and musculature *Pimea* parallels the Neotropical *Choeradoplana* which occurs in Brazil and Argentina. *Choeradoplana* differentiated from *Geoplana* Stimpson, 1857, and occupies a relatively small area suggesting the genus is a young one (FROELICH, 1967).

In *Pimea*, the presence of ventral testes, considered a primitive character in the Terricola (MEIXNER, 1928), together with specialized cutaneous longitudinal musculature, suggest that it has differentiated from Notogaenic geoplanid stock paralleling the Neotropical genus *Geoplana*.

FROELICH (1955) restricted *Geoplana* to forms with dorsal testes, and musculature the same as or close to GRAFF'S (1899) group (a) (strong longitudinal cutaneous muscle bundles and absent longitudinal parenchymal bundles). As a consequence of this restriction Notogaenic and Oriental geoplanas with ventral testes that belonged to GRAFF'S groups (a) or (b) (cutaneous muscle bundles weaker and looser than (a) but otherwise similar to it) could no longer remain in *Geoplana*. FROELICH (1955) suggested "The genus *Coenoplana* Moseley 1877 might be valid for them. The utilization of this generic name depends upon the reexamination of MOSELEY'S species which are deposited in the British Museum". FROELICH

(1959) tentatively assigned two species, and JONES (1988) three Australasian species to this Australian genus. CANNON (1986) includes the genus in his guide.

Recently OGREN & KAWAKATSU (1988a) proposed *inter alia* a correction of the long standing mis-spelling of *Caenoplana*, retention of MOSELEY'S (1877) definition of the genus (in which the important generic character of the position of the testes is not indicated), and formally adopted *Caenoplana* in describing *C. chapmani* from Papua-New Guinea (OGREN & KAWAKATSU, 1988b). However *Caenoplana* comprises two genera and unfortunately OGREN & KAWAKATSU (1988a, b) on procedural grounds designated *C. coerulea* as the type of the genus. Histological examination of the non-sexual type specimen of this species reveals weak cutaneous musculature (GRAFF'S group b) and in addition strong parenchymal musculature composed of small longitudinal muscle bundles mixed with circolo-oblique fibres arranged in a ring zone entally to the cutaneous nerve plexus. Immature testes are ventrally situated.

Histologically, the type of one of the other original species of *Caenoplana*, *C. sanguinea*, was found to have ventral testes, and longitudinal musculature that corresponds to GRAFF'S group (a). The species largely agrees with MOSELEY'S (1877) generic definition, thus paralleling *Geoplana*. For *Caenoplana*, *C. sanguinea* would therefore have been a more appropriate type species.

To clarify this problem *Caenoplana* should be redefined to accord with the anatomy of the *C. coerulea* the type species; *C. sanguinea* shall be transferred to a new genus characterised *inter alia* by ventral testes. GRAFF'S group (a) musculature or close to it, and absence of parenchymal longitudinal muscles (WINSOR, in prep.). It is from this latter geoplanid genus that *Pimea* probably differentiated.

Despite extensive sampling in the ORSTOM-MNH programmes, *Pimea* is known only from one locality. Thus at present it is uncertain whether this genus is a relatively young one, a phylogenetic survivor, or refugial relict.

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